

Configuration Manual

MSc Research Project
MSc in FinTech (MSCFTD1)

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MSc Project Submission Sheet
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Configuration Manual

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1 Research Environment Setup

For the purpose of ensuring reproducibility of this research, the following Table 1 presents all tools and devices that were used to set up the environment for conducting this study:

Table 1: Apparatus used for carrying out the research

Hardware / Software	Version	Description
ASUS Zenbook UX410U Laptop	Seventh-Gen Intel Core i7-7500u 8GB RAM DDR4 2,133MHz 2GB NVIDIA GeForce 940MX Windows 10 Home (v.21H2) b19044.1826	Workstation for conducting the research
Google Form		Web-based application for developing online questionnaire
Microsoft Excel	2206 (b15330.20264)	Spreadsheet software programme for viewing and managing obtained dataset from the survey
RStudio	4.1.1 (2021-08-10)	Software environment for statistical computing and graphics where the data analysis process was being carried out

Additionally, Table 2 demonstrates all R-packages that were being utilised during the data analysis process of this study:

Table 2: R-packages implemented on the data analysis process

R-packages	Version	Description
dplyr	1.0.7	Dataframe exploration + manipulation tasks
ggplot2	3.3.5	Data visualisation
ggthemes	4.2.4	Provide additional themes, geoms and scales for 'ggplot2' package
ltm	1.2.0	Latent variable modeling
QuantPsyc	1.6	Univariate and multivariate data screening
energy	1.7.10	Multivariate inference
lavaan	0.6.11	Latent variable analysis (i.e. CFA and SEM)
semTools	0.5.6	Extension of 'lavaan' package for pooling results from multiple imputations
semPlot	1.1.5	Path diagram + visual analysis of SEM outputs
semptools	0.2.9.3	Customisation and post-processing of graphs output from 'semPlot' package

2 Data Analysis Framework

STEP 1: Pre-Processing

The collected survey data was displayed using Microsoft Excel and an initial pre-processing procedure was performed on the dataset by transforming two measured variables into eight-point Likert scale, namely the frequency of utilising e-wallet services (1 = “Never”, 8 = “More than once a day”) as well as e-wallet usage behaviour based on the total number of different transaction types (1 = “Never used E-wallet to perform transaction”, 8 = “Seven or more types of transaction performed using E-wallet”).

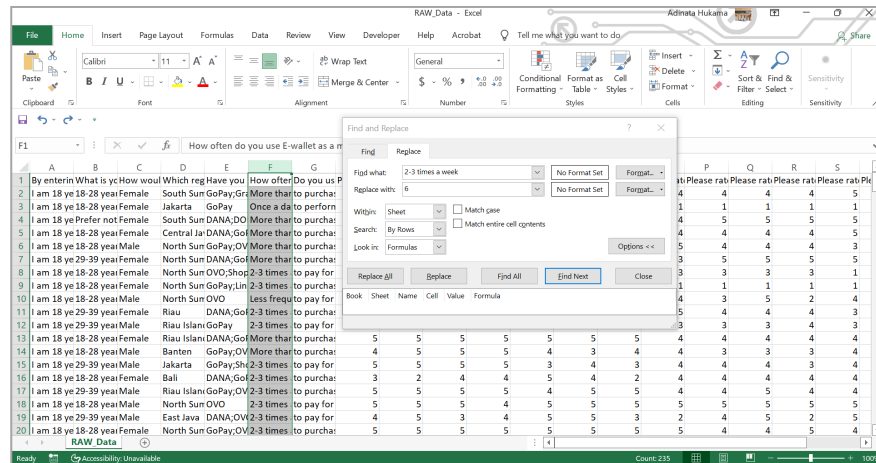


Figure 1: Transformation of e-wallet usage frequency using replace function in Microsoft Excel.

STEP 2: Data Investigation and Exploratory Analysis

The pre-processed data was then imported into RStudio for further preparation which involved checking for any missing values; casting age and gender variables as ‘factor’ data type; as well as employing ‘*dplyr*’ package to inspect the respondents’ demographics profile. Descriptive statistics were then produced to provide a general overview of the measured variables’ distributions; along with carrying out exploratory data analysis on the dataset by plotting graphs and diagrams using ‘*ggplot2*’ package to examine potential relationships/patterns that might exist between variables.

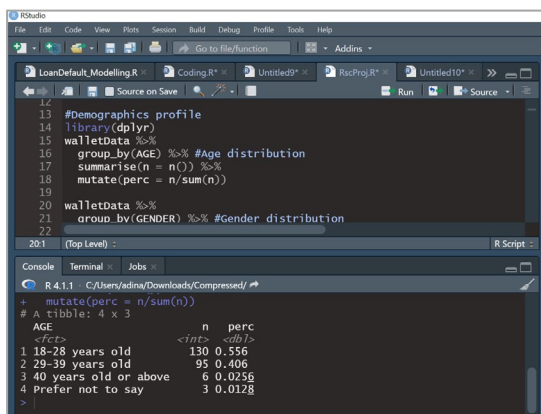


Figure 2: Inspection of respondents’ demographics profile using ‘*dplyr*’.

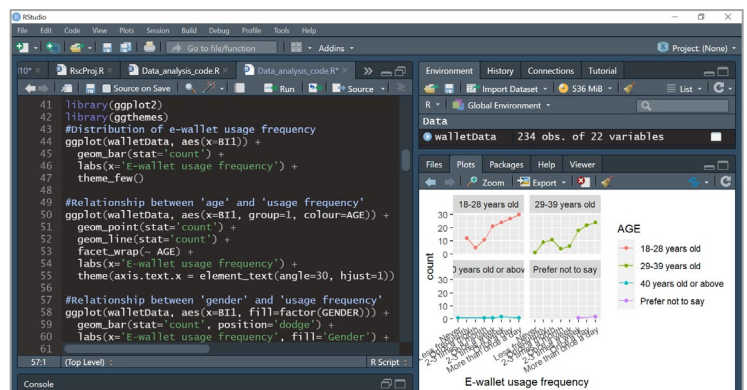
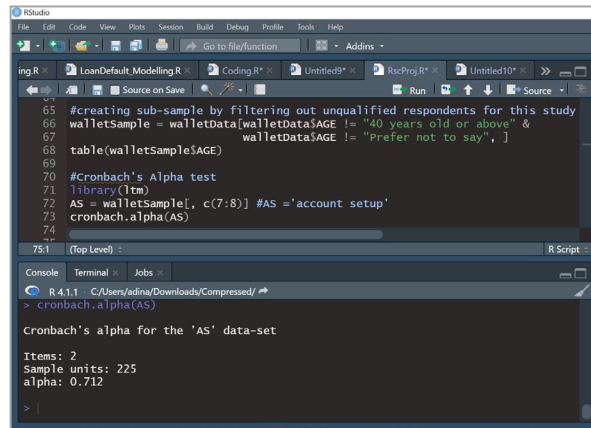


Figure 3: Exploratory analysis through data visualisation using ‘*ggplot2*’.

STEP 3: Structural Equation Modeling (SEM)

SEM analysis was performed in due course by following a two-step approach with firstly being the measurement model testing which requires the imputation of Cronbach's α for each latent variable using 'ltm' package as part of reliability test for gauging the internal consistency.



```
65 #creating sub-sample by filtering out unqualified respondents for this study
66 walletSample = walletData[walletData$AGE != "40 years old or above" &
67   walletData$AGE != "Prefer not to say", ]
68 table(walletSample$AGE)
69
70 #Cronbach's Alpha test
71 library(ltm)
72 AS = walletSample[, c(7:8)] #AS = 'account setup'
73 cronbach.alpha(AS)
74
```

75:1 (Top Level) R Script

Console Terminal Jobs

R 4.1.1 C:/Users/adina/Downloads/Compressed/

```
> cronbach.alpha(AS)

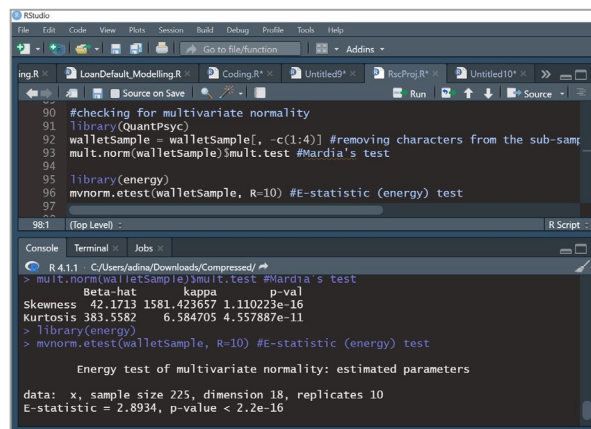
Cronbach's alpha for the 'AS' data-set

Items: 2
Sample units: 225
alpha: 0.712

>
```

Figure 4: Computation of Cronbach's α by utilising 'ltm' package.

As SEM analysis assumes a multivariate normal distribution, both Mardia's test as well as E-statistics (energy) test were then employed by utilising 'QuantPsyc' and 'energy' packages respectively for checking multivariate normality of the measured variables.



```
90 #checking for multivariate normality
91 library(QuantPsyc)
92 walletSample = walletSample[, -c(1:4)] #removing characters from the sub-samp
93 mult.norm(walletSample)$mult.test #Mardia's test
94
95 library(energy)
96 mvnorm.etest(walletSample, R=10) #E-statistic (energy) test
97
```

98:1 (Top Level) R Script

Console Terminal Jobs

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```
> mult.norm(walletSample)$mult.test #Mardia's test
      Beta-hat      kappa      p-val
Skewness  42.1713 1581.423657 1.110223e-16
Kurtosis  383.5582   6.584705 4.557887e-11

> library(energy)
> mvnorm.etest(walletSample, R=10) #E-statistic (energy) test

Energy test of multivariate normality: estimated parameters
data: x, sample size 225, dimension 18, replicates 10
E-statistic = 2.8934, p-value < 2.2e-16
```

Figure 5: Multivariate normality testing through Mardia's test and E-statistics (energy) test.

Second-phase of the SEM analysis, which involved structural model testing, was subsequently carried out through 'lavaan' package for determining the causal relationships among factor constructs. And additionally, the average variance extracted (AVE) for each factor was extracted using 'semTools' package to be examined for convergent validity and discriminant validity tests.

```

98 #Structural model testing
99 library(lavaan)
100 structural = '
101 BI =~ BI1
102 AU =~ AU1
103 AS =~ AS1 + AS2
104 EU =~ EU1 + EU2 + EU3
105 DN =~ DN1 + DN2
106 SP =~ SP1 + SP2 + SP3 + SP4
107 FC =~ FC1 + FC2 + FC3
108 PE =~ PE1 + PE2
109
110 EU ~ AS + DN
111 BI ~ EU + PE + SP
112 AU ~ BI + FC'
113
114 #utilising MLM estimator
115 analysis_1 = sem(structural, data=walletSample, estimator='MLM')
116 summary(analysis_1, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE)
117
118
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```

Figure 6: Performing SEM analysis through 'lavaan' package.

```

117 analysis_1 = sem(structural, data=walletSample, estimator='MLM')
118 summary(analysis_1, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE)
119
120 #utilising ULS estimator
121 analysis_2 = sem(structural, data=walletSample, estimator='ULS')
122 summary(analysis_2, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE)
123 lavInspect(analysis_2, what='cor.lv') #extracting correlation matrix of later
124
125 library(semTools)
126 round(reliability(analysis_2), digits=3) #acquiring average variance extracte
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Figure 7: Extracting AVE for each latent variable by using 'semTools'.

Lastly, a diagram of the path analysis was produced by using 'semPlot' and 'semptools' packages to provide greater insights towards factors that significantly influence the adoption of e-wallet services.

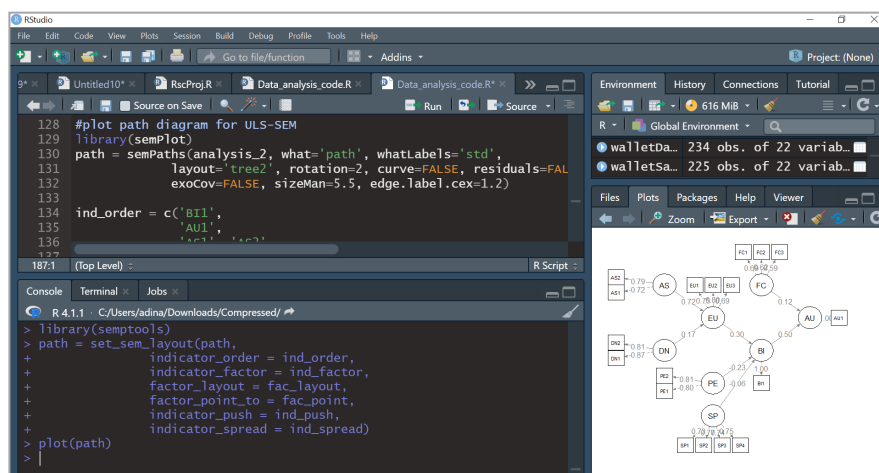


Figure 8: Generate diagram for the path analysis results by employing 'semPlot' and 'semptools'.

Appendix

Link to the online questionnaire:

https://docs.google.com/forms/d/e/1FAIpQLSfG_nPfgUmjRT8KNEN-k3jvHPGqaLqf7VWSAt0yboucNkQw2w/viewform?usp=sf_link